

MECHANICAL SYSTEMS

WHEN TO CONSIDER

NEEDS ASSESSMENT	NO	SCHEMATIC DESIGN	YES
MASTER PLANNING	NO	DESIGN DEVELOPMENT	YES
PROJECT STATEMENT	MAYBE	CONSTRUCTION	
ARCHITECTURAL		DOCUMENTS	DONE
PROGRAMMING	YES	CONSTRUCTION	DONE
NO-Need not consider.			
MAYBE-This system may be considered.			
YES-This system should be considered.			
DONE-This system should have already been considered.			

DESCRIPTION

The building's mechanical system provides the environmental control, including heating, cooling, fresh air supply and humidity. This system typically costs 10 to 15 percent of the cost of the building, depending on the climate, design of the building envelope, and the type of systems selected to provide the desired environmental conditions in the building.

The most important thing you can do to get the mechanical you need, want and can afford is communicate these goals to your designer. The designer needs to know:

- How you will use each space and how many people will be located there.
- Your environmental needs for each space. Do you want to heat the space only or heat and cool the space? If the space is cooled, what temperature do you want to maintain? Just because a space will be cooled doesn't mean the space must be cooled to what most people think of as air-conditioned.
- Your budget for the mechanical system: As discussed in the introduction of Section III, the design-to-cost model breakout of the project should allocate dollar resources to each building system so the design can be developed according to a budget amount for each system. When designers are unaware of budget parameters, they will strive to "give" the client the "best" system possible. As with most things, the "best" system is the most expensive solution. Therefore, it is essential the architect, as coordinator of all the consultants, communicates the budget parameters for the mechanical system.
- The amount of control you wish to maintain from space to space in the building. Controlling the environment in each room differs in price substantially from controlling a number of adjacent spaces together.
- The type of equipment and lighting fixtures you want in each space. Because equipment and lighting emit heat, the cooling portion of the system must be able to accommodate these loads. This heat gain will offset the heating needs of a space.

Because your architect is responsible for the overall coordination of the systems within the building, the mechanical consultant will be working for the architect. It is the architect's job to make sure all of this information is collected and communicated to the mechanical consultant. If these questions are not being asked, the mechanical designer may be basing the design on assumptions from previous similar projects. Generally, such assumptions lead to an over-designed system.

Life-cycle cost is important when selecting your mechanical system. The energy cost to run the system, the equipment replacement time, and the amount of control should be compared to the first-cost. In general, the more expensive first-cost systems typically provide more control and have greater longevity than low first-cost systems. Analyze your options. As with any life-cycle analysis, the figures are derived from many subjective assumptions. Scrutinize these assumptions more so than the bottom line cost to make a prudent decision, whether the pay-back on a more expensive system is worth the first-cost and if you have enough first-cost dollars to pay for the "best" system.

When your design team is presenting options on first-cost versus life-cycle cost, be aware that a complicated "energy efficient" design will only be energy efficient and provide a better environment if properly maintained. Therefore, a simpler, less expensive and perhaps less comfortable system (in terms of controls) may, in fact, prove to be a more economical choice in life-cycle terms because it will be easier to maintain. To avoid buying a complicated mechanical system which looks good on paper, involve a staff maintenance person when you make your selection. If that person doesn't understand how it works and what it will take to maintain it, the "best" choice may be wasted.

RELATIONSHIP TO OTHER SYSTEMS

The mechanical system must fit among the other building components, such as roofs, ceilings, columns and beams, piping and ductwork. The equipment must be accommodated inside the building, on the roof or on the ground. The electrical system will affect sizing of heating and cooling loads because of the heat it generates. In a secure environment, inmate access to the system's components becomes an important consideration.

ALTERNATIVES

Because of the volume of information required to describe all of the systems available (the most common are listed in the matrix), a discussion of each in this Handbook is not

practical. The matrix should be used as a general reference. Discussion of some general differences follows.

Centralized Systems Versus Decentralized Systems

A centralized system uses heating or heating and cooling devices located throughout the facility, piping or ducting a heated or cooled medium (steam, hot water or air) to various locations throughout the system. This system can service one or a number of buildings. You have greater control with a central plant; its primary equipment is designed for long-term use. First costs and energy costs usually are higher.

Decentralized systems use a number of heating or heating and cooling devices located throughout the facility. The energy source, typically gas, for heating and electricity for the cooling are delivered directly to the units. First-costs are usually lower and energy costs also may be. Control, however, is not as good, and some of the equipment is not designed for longterm use.

Gas-fired unit heaters (typically found in industrial and warehouse/maintenance facilities) are found at the low end of the cost scale. Central heating and cooling plants define the high end. It is very common to use a variety of equipment for one facility to serve different purposes. For instance, you can use unit heaters in the storage and maintenance areas, evaporative coolers in the housing areas, and a variable air volume system for the administrative areas. The cost per square foot for these alternatives will range from under \$14 per square foot to \$25 per square foot. Mechanical needs for each space should be considered separately.

Mechanical Systems Matrix

		ALTERNATIVES									
		VARIABLE AIR VOLUME W/CENTRAL CHILLER & BOILER	VARIABLE AIR VOLUME W/CENTRAL BOILER & DIRECT EXPANSION COOLING	VARIABLE AIR VOLUME PACKAGE UNIT GAS EXPANSION COOLING	SPLIT SYSTEM HEAT PUMP	CONSTANT VOLUME HEAT PUMP	PACKAGE UNIT GAS-FIRED ELECTRIC COOLING	DRY EVAPORATIVE COOLER	EVAPORATIVE COOLER (SWAMP COOLER)	GAS FURNACE HEATING ONLY W/DUCTING	UNIT HEATERS (NO DUCTING) HEATING-COOLING
CRITERIA	COST	LOW									
		MEDIUM				●	●	●	●		
		HIGH	●	●	●	●		●			●
	LIFE CYCLE-EQUIPMENT	LOW									
		MEDIUM	●	●	●	●	●	●	●		
		HIGH	●	●	●	●	●			●	●
	LIFE CYCLE-ENERGY	LOW COST									
		MEDIUM		●	●	●	●	●	●	●	●
		HIGH COST	●	●	●	●	●	●		●	●
	CONTROL	LOW	●						●	●	●
		MEDIUM		●	●	●	●	●	●	●	●
		HIGH	●		●	●					●